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A Contribution to the Physiology of the Museum Beetle, *Anthrenus museorum* (Linn.).

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[Read 6th December, 1906.]

The larvæ of this small beetle have worked terrible havoc in the National Herbarium at Melbourne, and its ravages are only kept in check by placing the portfolios of plants in a chamber impregnated with the vapour of carbon bisulphide for two or three days at regular intervals. This work is continually in progress, so that each plant is subjected to the vapour once a year. Permanent poisoning by mercurial or arsenical poisons is inadvisable on account of the danger to health when large bulks of the dried plants are frequently handled in a dry dust-forming atmosphere.

Naphthalin, though it may aid in keeping away the adult beetles, has no effect upon the larvæ, which were found to be still alive, after remaining for a week in a closed tin box containing a ball of naphthalin. The most remarkable feature about the larvæ is of course their power of feeding on dry materials without any apparent supplies of water. It is true that imperfectly dried specimens are most liable to attack, but nevertheless I have found the grubs in an active condition on plants containing slightly less than 9 per cent. (8·8 per cent.) of water.

The larvæ themselves contain about the same percentage of water as do those of allied insects, the percentages being found to vary between 68·5 per cent. and 71·8 per cent.

The lowest limits were found in quite young larvæ, and in those approaching the beetle stage, the percentage being highest when they are actively feeding and nearly full grown. The plant specimens from which the above grubs were taken contained 9·4 to 11 per cent. of water, whereas the excrement collected in as fresh a condition as possible contained from 15·8 to 19·4 per cent. of water. Within the parcels of plants stored in close cupboards or tin cases in which these larvæ were found, it is hardly possible to conceive of there being a sufficient condensation of water to explain this gain in moisture. It is worthy of note that the larvæ seem to have a minimum rate of transpiring water, for of a number placed in a desiccator, the majority were still living after a week at 12° C., without any supplies of water or food.

When feeding on dried plants only two direct sources of water are available for the larvæ. These are the imbibed water retained in the dried material, and that condensed on the surface by fall of temperature. The former averages 7 to 20 per cent. in herbarium specimens, although naturally higher in fresh imperfectly dried ones, and those which have been exposed to moist air.

As regards the latter source of water, careful microscopical examination of feeding larvæ on plants previously moistened by steam failed to reveal any attempt by the larvæ to squeeze out water from the material and swallow it. The damper parts of the material, which are the central portions in the case of freshly dried fruits, stems, and flowers, are more attacked by the larvæ, but these seem merely to take in the imbibed water along with the material containing it. Some other supply of water appears therefore to be needed to explain the high percentage in the animal's body, and the increased percentage in the excrement as compared with the food.

A possibility worthy of consideration is whether this water may not be chemical in origin, being derived from the carbohydrate food and set free in the animal's body by the oxidation of the carbon in respiration.

If this were the case we should expect to find the larvæ having an unusually high production of CO_2 and increasing in weight in a desiccator if provided with dry carbohydrate food.

Experiments in Desiccator.

(1) 25 grubs, two of which were very small, weighed 0·06 gramme. After being for 12 days in a sulphuric-acid desiccator at 10 to 12° C. with leaves and stems previously dried for several days in a desiccator at 15° C., 17 grubs were living, the two very small ones appearing distinctly larger, and weighed

0·038 gramme; eight grubs were dead and dried hard; the total weight of the whole 25 being 0·05 gramme, a loss of weight of 0·01 gramme.

Assuming that the dead and living grubs averaged the same weight at first, the living grubs have gained 0·0016 gramme in weight ($0·038 - \frac{17}{25} \times 0·06 = 0·0016$). The dead grubs showed no signs of external injury, but nevertheless the possibility remains that the moisture exhaled from them may have been condensed and absorbed in some way by the living grubs.

(2) The 17 living grubs weighing 0·038 gramme were returned to the desiccator with the plant material, and after 14 days at 8 to 10° C., 12 remained living and capable of moving. They weighed when brushed clean 0·028 gramme. This equals an apparent gain in weight on the above assumption of 0·0016 gramme ($0·028 \times \frac{17}{12} - 0·038$), the two smaller grubs being still living. As before, however, this moisture may have been gained from the dead grubs, for the twelve living and five dead and shrivelled ones weighed altogether 0·033 gramme, a loss of weight of 0·005 gramme. On the other hand, the loss by respiration has to be considered, for judging from the amount of excrement the grubs fed little or not at all upon the desiccator dried material, and seemed rather to devote their energies to protecting themselves against transpiration.

(3) *Respiration.*—The remaining 0·028 of a gramme of living grubs were placed in 2·5 c.c. of air for 18 hours at 8 to 10° C., and the residual gas analysed in a Bonnier and Mangin gas apparatus. No measurable quantity of carbon dioxide was present, probably as the result of the poisonous action of the mercury, the grubs being dead at the end of the experiment.

(4) 25 medium-sized active grubs weighing 0·083 gramme were placed, with 1·044 gram of plant material dried, in a desiccator at 10° C. until a constant weight was reached. A similar amount of plant material tested in the same way still contained 4·8 per cent. of moisture, or at least lost that weight when heated to 100° C. for 8 hours, so that the 1·044 gramme may be taken to still contain 0·05 gramme of water.

After 14 days in a desiccator at 8° to 10° C., the total loss of weight was 0·092 gramme. 22 living grubs weighed 0·063 gramme, and with the three dried and shrivelled ones, 0·072 gramme. The living grubs apparently therefore lost 0·012 gramme in weight ($0·083 - 0·063 \times \frac{25}{22}$), while the apparent loss converted into CO_2 would be 0·0084 gramme.

The 0·063 gramme of living grubs were sealed in a tube with 1·6 c.c. of air, and after 24 hours were found to have produced at 8° to 10° C., 0·000525 gramme of carbon dioxide, which in 14 days gives a total production of 0·0024 gramme, which is less than one-third the apparent loss. The difference of 0·006 of a gramme is partly due to the loss of water by dead grubs, and partly to respiration being more active at the commencement of the experiment. The relative activity of respiration may be seen from the following table:—

Organism.	CO_2 in mg. per gr.	Temperature.	Time.
Grubs after 14 days in desiccator	2·7	10° C.	24 hours.
			24 ,,
Potatoes	0·08 to 1·44	15°	24 ,,
Man	7·2 to 12	37–38°	24 ,,
Dog	13·4	37–39°	24 ,,
Horse	9·9	38·3°	24 ,,
Fresh actively feeding grubs	5·4 to 8·8 *	10–15°	24 ,,
			24 ,,
Frog	0·912	13°	24 ,,
,,	8·52	19–20°	24 ,,
Tench	1·73	14°	24 ,,
Cray-fish	1·54	12·5°	24 ,,
Cockroach	6·24	15–20°	24 ,,
Earthworm	2·59	,,	24 ,,†

* These values are probably too high, the larvæ being heated to 100° C. at the close of the experiment so that all the CO_2 contained in their bodies was driven out.

† Some of the numbers are from values supplied by Prof. Osborne.

When actively feeding, the respiratory activity of the grubs is even at low temperatures nearly as high as that of a warm-blooded animal, but a part of the CO_2 produced may be due to bacterial action in the alimentary canal.

Bacteria are present in abundance in the alimentary canals of actively feeding grubs, and since these bacteria feed on the carbohydrate food and oxidize its carbon under conditions where no transpiration of water as vapour is possible, a certain increase in the percentage of free water in the alimentary canal must be produced in this way. This may be the explanation of the slight rise observed in the percentage of moisture contained in fresh excreta as compared with the food, but it is uncertain whether the larvæ absorb internally any of the moisture set free in this way.

It follows from the above data that under unfavourable conditions as regards temperature or the supply of moisture and food, the respiratory activity of the grubs is reduced considerably. At the same time the loss of moisture is largely controlled by the living animal, for in a desiccator, dead grubs dry rapidly, whereas living ones retain their moisture for a long time even when no apparent external supply of moisture is available and when not actively feeding. They cannot live for more than a limited space of time in dry air on material containing less than 10 per cent. of water, and may lose more than 10 per cent. of their moisture within a fortnight in a desiccator.

When actively feeding and respiring, the oxidation of the carbon in their carbohydrate food sets free a certain amount of water which, aided by the imbibed water retained in the plant-tissues, suffices, if the latter is over 10 per cent. in amount, for their aqueous requirements. The grubs do not seem to have any power of condensing water vapour from the air, although naturally any moisture condensed on the surface of a plant by a fall of temperature may be taken in by them with their food. Grubs observed under the microscope do not seem to swallow any of the moisture film condensed on glass, although such moisture may be taken in through the general surface of the body. A point worthy of mention is that the percentage of moisture in a dried plant specimen is rarely uniform throughout, and that the grubs may be feeding and thriving on the moister parts of a specimen which seems as a whole prohibitively dry. Nevertheless the experiments show that reduced as are the moisture requirements of the larvæ, thoroughly dried specimens kept in dry air in which no condensation of moisture occurs at any time are practically immune from attack. In this connection the absence of anything capable of aiding in the condensation of water is of importance, such as sugary gum and certain kinds of glazed paper.

Note on the Origin of the Name *Chermes* or *Kermes*.

By E. R. Burdon, M.A., F.L.S.

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Great confusion has arisen from the fact that there are two genera of insects, both belonging to the Hemiptera, which bear the same name under different spellings. One of these is the genus *Chermes* included in the family Aphidæ, while the other belongs to the Coccidæ and is spelt *Kermes*. According to Kirkaldy (1) there is yet a third genus of the Hemiptera which bears this name, viz. that usually known as *Psylla* belonging to the family Psyllidæ. Kirkaldy, enforcing the rules of priority in nomenclature, states that *Psylla* should be called *Chermes*, and that the name of the family ought to be Chermidæ instead of Psyllidæ.

I leave it for others to decide whether this statement is correct or not, but even supposing that the correct name of *Psylla* is *Chermes*, it would, I consider, be a great mistake to insist upon the observance of the laws of priority in the present instance. The confusion between the Aphid *Chermes* and the Coccid *Kermes* is already so great, that it is no easy work to disentangle the literature relating to either genus. This difficulty has to some extent been overcome by a sort of tacit agreement to accept the difference in spelling as sufficient indication of the particular genus referred to. *Chermes* is used by most authorities for the Aphid genus, and an extensive literature is to be